Project Title
Fingerprint Authentication System

Project Description
In this hands-on project, you will work in groups of two to design and implement a simple fingerprint authentication system. The goal is to create a basic but functional system that can enroll users by processing their fingerprint images and verify their identity using the enrolled data. Your implementation should include the following components:

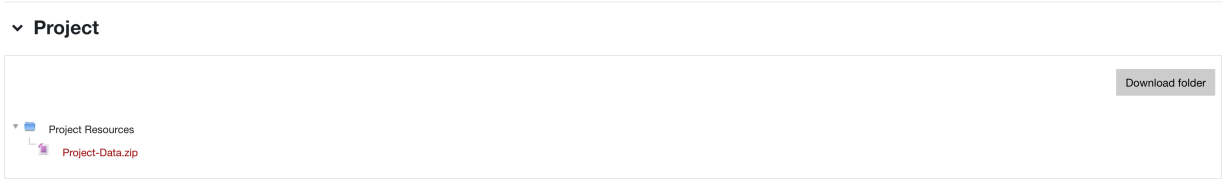
- Preprocessing: Implement image preprocessing techniques to enhance the quality of captured fingerprint images. This may include noise reduction, image enhancement, and normalization.
- Feature Extraction: Utilize fingerprint recognition algorithms to extract relevant features from the fingerprint images.
- Enrollment and Matching: Develop a matching algorithm to compare the extracted features of an input fingerprint against the enrolled data in your system's database. The system you build should be able to identify unseen fingerprints.
- Evaluation: Evaluate the performance of the built fingerprint authentication system and visualize the results.

Project Deliverables
A brief presentation (10 minutes) describing the system design choices you made, the algorithms used, and any challenges faced during implementation.

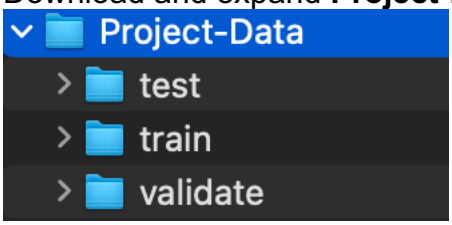
Project Evaluation
Your project will be evaluated based on your slides and presentation.

Note: Please remember that this project is designed to help you understand the fundamentals of fingerprint authentication systems. While your system should work, it doesn't need to be a fully-fledged, production-ready application. Focus on learning and applying the concepts discussed in the course.

Data
Fingerprint dataset can be downloaded from **Moodle**.



Download and expand **Project-Data.zip**. It contains the following *three* folders.



train: fingerprint images for enrollment
validate: fingerprint images for identification. Some fingerprints are never seen in the **train** folder (open-set identification). You can use the **train** folder and the **validate** folder to observe, debug, and tune your system.
test: fingerprint images that you will use for system performance evaluation. Note that you should NOT use the images in the **test** folder for system tuning or debug. These test fingerprint images emulate the fingerprints your system will receive after deployment.

The dataset files have the filename format as
YYY_R0_KKK.bmp
where **YYY** is the ID of the person who provided this fingerprint image, **KKK** is the index of fingerprint images. For example, 000_R0_0.bmp, 000_R0_1.bmp, 000_R0_2.bmp, 000_R0_3.bmp, and 000_R0_4.bmp are the five images of the same finger of person ID=000